

Breakthrough European tEchnologies Yielding cOnstruction sovereigNty, Diversity & Efficiency of ResourceS

BEEYONDERS Pioneering worker-friendly technologies for Europe's construction sector







Funded by The European Union

Edgar Valverde Estrella – PNO Innovation – BEEYONDERS Exploitation manager

Sustainable Places 2024 Luxembourg (September 25th, 2024)

About BEEYONDERS

- Start Date: June 2022
- Duration: 42 months
- Partners: Coordinated by Acciona, the project counts on the participation of 21 partners, two affiliated companies and one associated country.

TRL from 4 to 6







About BEEYONDERS

A unique opportunity to increase the competitiveness of European companies in the construction sector by producing, commercializing and integrating beyond the state-of-the art solutions into real construction scenarios.







BEEYONDERS objectives

To improve or increase



... in the construction sector





Our Technologies







BEEYONDERS impact

Improvement of efficiency in resources (raw materials, water...)

Reduction of waste and embodied CO2 emissions

Increased independence of imported technologies





Expected Impacts



Less CO2 emissions by the construction sector



Improvement of efficiency in production



Increase in workers' endurance



Reduction in sick leave due to lower back injuries





Case studies

BEEYONDERS technologies will be demonstrated into 6 construction pilot scenarios in multiple infrastructure typologies







Tunnel construction

LOCATION Santa Barbara Foundation Test Tunnel, León (Spain)

TECHNOLOGIES IMPLEMENTED Autonomous and teleoperated ground/air robotic solutions applied to construction machinery







Road construction

LOCATION 24 highway, Firenze (Italy)

TECHNOLOGIES IMPLEMENTED Ground/air autonomous navigation of vehicles and use of Digital Twin and AI functionalities







Maritime construction

LOCATION Port of Gijón (Spain)

TECHNOLOGIES IMPLEMENTED

Structural design and optimization of caisson and reefs







Maritime construction -EU-Japan collaboration

LOCATION

Port of Rotterdam, Dutch National test site (The Netherlands)

TECHNOLOGIES IMPLEMENTED Use of data to provide insights and realtime designs and feedback in push-in pile machinery process







Road maintenance

LOCATION A24 highway, Rome (Italy)

TECHNOLOGIES IMPLEMENTED Autonomous Robotics







Building construction

LOCATION Helsinki Metropolitan Area, Southern Finland (Finland)

TECHNOLOGIES IMPLEMENTED Wearables, drones & exoskeleton







BEEYONDERS exploitation strategy beyond the EU project







Vision

To become the legitimate hub for digital and sustainable construction sector and showcasing and promoting all major EU and national initiatives, structures and digital ecosystems.

Mission

To transform EU construction sector in their twin (digital and sustainable) transition by facilitating the links between all actors and assets that are required for such transition.





Services

Public interest methodologies and success stories (from and beyond BEEYONDERS). Catalogue of products and solutions either to find investors to be matured and reach the market or as already commercial products.





Value proposition

- One-stop-shop for the twin transition of construction industry.
- High quality and accessible repository of methodologies and success cases.
- High quality and accessible catalogue of validated commercial or close to market first of a kind solutions for the twin transition of the construction industry.
- Unequal spotlight for experiences in the twin transition of construction industry, with particular attention to success cases that can inspire other target groups on their own pathway.





Challenges

- Create alliances to refine proposed approach.
- Define strategies to launch the SEPD.
- Explore sustainability models.







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Min humantech

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CIFK Dr. Jason Rambach Project coordinator German Research Center for Artificial Intelligence, DFKI



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Why HumanTech? Our mission

The European construction sector faces 3 major challenges:
1. increase the **safety** and well-being of its workforce,
2. improve its **productivity**,
3. become **greener**, making efficient use of resources.

HumanTech addresses the most important challenges faced by the European construction industry today — making it safer, greener and more efficient.





HumanTech Technologies





вливот



humantech











PLACES 2024



Semantic Digital Twin : Scan-to-BIM pipeline

R

Ρ





Rheinland-Pfälzische Technische Universität Kaiserslautern Landau





Semantic Segmentation

R

Ρ







Rheinland-Pfälzische Technische Universität Kaiserslautern Landau





Clustering & Primitive Fitting















Wall closing - Merging



R

Р



TU Rheinland-Pfälzische Technische Universität Kaiserslautern Landau





Scan-to-BIM Pipeline Today

o Awards: 2x3rd place at CV4AEC Scan-to-BIM challenge @CVPR 2023 and CVPR 2024

o Improving Al Segmentation Model - Data!

o Extend to support more object **classes**

o Exploring further Scan-to-BIM **Use-cases**







HumanTech: The Team

22 organisations, 10 countries
7 research institutes
9 Innovative SMEs and large enterprises
5 construction groups and a construction SME representative

https://humantech-horizon.eu/











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humantech

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https://www.linkedin. com/company/human tech-eu/

Thank you!

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sustainable building innovations

Sustainable Constuction & BIM

Douwe Feitsma, Van Wijnen

21-10-2024 Sustainable Places Conference



VAN WIJNEN

- Dutch construction company established in 1907
- Project development, residential construction, renovation, transformation, and property management
- 27 locations across the Netherlands
- Employs over 2,300 people
- Improving quality of life for residents and communities through innovative approaches emphasizing collaboration, quality, and safety



Douwe Feitsma Project coordinator InCUBE





21-10-2024

UNLOCKING THE EU RENOVATION WAVE



An inclusive toolbox for accelerating and smartening deep renovation

InCUBE envisions to unlock the EU renovation wave through **cutting-edge standardised and integrated processes** based on industrialisation, innovative renewable energy technologies, digitalisation, and new market entrants. InCUBE strives for **social inclusion**, **upskilling**, **and supporting women** in the construction industry.

The InCUBE solutions will be demonstrated in 3 large-scale demo sites: Zaragoza (ES), Trento (IT) and Groningen (NL).



ABOUT

InCUBE brings together 23 high-profile partners and two affiliated entities from 7 European countries.



Funded by	European Union
Programme	Horizon Europe Research & Innovation programme
Start project	July 2022
End project	June 2026
Budget	~€10 million
EU Funding	~€8 million



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21-10-2024

THE PROBLEM AND THE NEED

Low rates of productivity & user satisfaction in the construction sector	 Market up-take of new, sustainable materials Industrialisation of deep renovation Upskilling workforce under a gender mainstreaming approach
Poor or no integration of solutions	 Improved integration of solutions and digitalisation of products and processes More attractive and affordable solutions
Limited information of building whole life cycle	 Integration of building related information Buildings and their users as active nodes of the energy system
Highly complex, fragmented and project-based process	Bring together different actors of the construction sectorWorkflow optimisation



21-10-2024

KEY EXPECTED OUTCOMES





Reduction of waste streams and time needed on-site

35%+



Reduction in renovation costs



50%+

Reduction in working time with hazardous activities



20%+

Energy performance gap between as-built and as-designed.





Greenhouse gas reductions

62%+ Energy savings per year



2000+ users

In two Renewable Energy Communities



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EXPECTED OUTCOMES



More energy efficient building stocks supported by an accurate understanding of buildings performance in Europe and of related evolutions



Building stocks that **effectively combine energy efficiency**, **renewable energy sources and digital and smart technologies** to support the transformation of the energy system towards climate neutrality



Higher buildings' performance with lower environmental impacts through increased rates of holistic renovations



Creating a superior yet cost-effective constructed environment that safeguards the climate, ecology, and cultural heritage, while also enhancing living conditions.



INNOVATIONS

InCUBE envisions to unlock the EU renovation wave through cutting-edge standardised and lean integrated processes based on **4 key pillars of innovation.**











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Machine-Human Collaboration

Robotization



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BIM-CONNECTED DEMOLITION ROBOT

ARERobot ARE 1.0

- Innovative aspects
 - BIM-connection
- Challenges
 - Weight and size of the robot

• Outcomes

- No increased speed of demolition works
- Increased health and safety of construction site workers
- Physical effort still required for disposal of waste
- Parts of the floor still cleared for safety purposes
- Looking ahead
 - Optimal deployment when operating in open areas
 - Increase data and LoD of BIM model





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BIM-CONNECTED DRILLING ROBOT

Hilti Jaibot

- Innovative aspects
 - BIM-connection
- Challenges
 - Weight and size of the robot
 - Existing cables, pipelines and anchors still in place

• Outcomes

- Increased execution speed
- Increased health and safety of construction site workers
- Looking ahead
 - Optimal deployment when operating in large open areas





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SCAN-TO BIM

Laser 3D scanning and UAV-based aerial georeferenced photogrammetry

- Innovative aspects
 - Combination of technologies
 - 3D laser scanning, UAV-based photogrammetry and topographical survey
- Challenges
 - Weather conditions
 - Flying in controlled airspaces

Outcomes

- Deeper examination of building, pathologolies and geometry
- Indicating deviations in building
- Looking ahead
 - Potentially higher resolution





21-10-2024

RESILIENCE DASHBOARD

• Innovative aspects

- Monitor complex worksite operations
 - Worker safety
 - Environmental monitoring
 - Site logistics
 - Waste management
- Digital twin to track construction advancements

• Outcomes

• Optimization of construction site logistics





DIGITAL CONSTRUCTION SITE (TRENTO)





Streamlining Innovative Materials

Prefabrication and new materials



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BIM-BASED DESING OF PREFAB FACADE ELEMENTS

• Innovative aspects

- Expanding available space
- Integrated PV panels
- Challenges
 - Fire testing to conform with fire class B
- Expected outcomes
 - Reduction of working time with hazardous activities
 - Reduction of assembly time on site













REINCARNATE

REINCARNAT

André van Delft, DEMO Consultants



Funded by the European Union





Project Intro

Mission

Reincarnate aims to revolutionise the construction industry by developing the technical and social means to establish a reincarnation practice within the building sector



 Maximize the cumulative virtues of a building, a building product, or a building material during its life

Establish a transparent track record of these virtues

Use this track record — and the high degree of reliability and trust that comes with it — to ensure





Partners



Systems Engineering and Material Science | Construction Materials



Social Science, Innovation Management and Standardization



Real Estate | Architecture | Construction | Engineering



Computer Visions and Robotics | Internet of Things and BIM



Waste Management





Objectives and Scope

Challanges







Construction and demolition waste (CDW) is the largest waste stream in the EU	Limited average lifespan	Low percentage use of secondary materials by the construction sector
Current CDW accounts for approximately 25-30% of all waste, which consists of numerous materials that often cannot be separated meaningfully.	The average lifespan of buildings is only 39.1 years. According to 3L, one of our team members,it is even shorter in the EU (in Germany, an estimated 25-30 years).	It is not possible to reuse entire buildings, building products, or building materials of high product quality within a different setting or for a different purpose.
The embodied energy and embodied eq. CO2 emissions in the CDW are significant (8.5 MT eq. CO2 for construction in Sweden in 2015).	The main reason for demolishing buildings is that they are functionally obsolete.	The building sector hardly uses any secondary materials.





Approach



At Reincarnate, we will advance circular economy practices in the building sector, feeding a closed cycle of extended use, reuse, and recycling.

How? Through innovations that will significantly reduce its emissions footprint and enable life cycle extension, reuse and recycling of construction products and materials.

CP-IM platform	The CP-IM will provide a digital representation of building materials and products with information on their life cycle. It will also allow assessing their potential for life extension and reuse, as well as predicting circular value streams.
10 innovations	From solutions for building inspection to construction and dismantling planning, and identification and classification of CDW — these innovations will draw upon emerging digital technologies , such as digital twin representation, artificial intelligence, and robotic automation.
11 demonstrators	All innovations will be demonstrated on eleven selected real-world projects and value chains (demonstrators).





Reincarnate Framework



The CP-IM will allow to store and capture all required data to understand the potential to extend the lifetime of a building, its building components, and materials, and to find optimal reuse possibilities for each of its elements. It will also enable to trace construction products and materials across different buildings, waste management steps, and construction sites.

D

03 Innovations and Solutions

CPIM Platform





Robotic Disassembly

1. Developing an approach for aluminum frame windows disassembly



REINCARNATE

2. Testing our approach in the simulation environment







Robotic Disassembly









NDT Application

Non-Destructive Testing + IoT







Product Upgrade Solutions



 (hj_{1}^{2})

 (hc_3^4)

 hs_3^3

 (hj_2^3)

_(hc

Higher Level Decisionmaking Framework For Adaptive Reuse





Impact



Increase by 50% the reusability of construction products post demolition

REINCARNATE will release Minimum Viable Products (MVP) of the CP-IM and the REINCARNATE innovations by the end of the project reaching TRL6

Valuation methods for recycled materials and upgrade methods for construction products Automated Methods for assessing and separating CDW on site

REINCARNATE will suggest standards for fostering transparent and reliable practice across Europe

The project will achieve a Societal Readiness Level (SRL) score of SRL 6

Solutions for waste avoidance

Methods for dismantling construction products for reuse in high product quality

Social science supported insights in how to improve adoption behavior for recycled materials

Solutions for information modelling and management

Solutions for waste management



Thank you

http://reincarnate-project.eu/





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PROJECT OVERVIEW

Dr. Dimitrios Giakoumis Project Coordinator, CERTH/ITI



23-25th September 2024





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21/10/2024



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CONSORTIUM







21/10/2024





CONCEPT OVERVIEW JUSTAINABLE PLACES 2024












PROJECT CURRENT STATUS HIGHLIGHTS







- **CIM/BIM Implementation** for shotcrete activities
- Simulation Tool for construction processes
- IoT sensor integration with RoBétArmé Digital **Twin Application**
- RoBétArmé DT Platform advancement for shotcreting simulation
- **DSS development** based on user feedback

OLOGY

AR tool development

21/10/2024



NGENIEROS

ASESORES









Christiansen

& Essenbæk

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PROJECT CURRENT STATUS HIGHLIGHTS





Perception & Cognition for Construction Activities

- SoA Analysis of Methods for
 Vision Systems, including 3D
 Reconstruction, Semantic
 Segmentation & Volumetric
 Modeling
- Real-Time Monitoring in
 Turbid Environments
- Construction Site Orchestration & Task Planning













Collaborative Robotic Skills for Autonomous Construction & Maintenance

- Experiments in testbeds
- Implementation of basic
 library of motions learned
 from the nozzlemen's skills
- Evaluation of various approaches for shotcreting & surface finishing task planning & control











EPFL

PROJECT CURRENT STATUS HIGHLIGHTS



CEAS Testbed









СОВОД





System Integration, Pilots Deployment & Human-Centered Evaluation

- Design of two platforms: SFR & IRR & trailer for Metal Additive Manufacturing
- SFR Manipulator 1st
 Prototype
- Metal Manipulator Design
 & Nozzle Extrusion Control
- Shotcrete Mix-Design Methodology

SFR





- Construction of Testbeds: Initial Recording at CEAS
- Planning to construct a Large Permanent
 Structure to incorporate four Use
 Case Scenarios







THANK YOU FOR YOUR ATTENTION

ANY QUESTIONS ?





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